THE MATHEMATICS TEACHER

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MATHEMATICS FOR THE JUNIOR HIGH SCHOOL.*

BY GEORGE W. EVANS.

We have had a committee of the Association of Teachers of Mathematics in New England appointed to deal with the criticisms brought against the teaching of mathematics in secondary schools. This attack has been vigorous, and in many cases thoughtful.

Our critics have pointed out that the teaching of mathematics in secondary schools, and particularly the teaching of algebra, has been remote in its nature from the interests of the pupils of that age; that it has had little content suitable for application in the immediate present; and that the prescriptive character of the mathematics program served to exclude subjects that might well be thought more desirable for pupils who were not to go to college, and for those that were likely to be seriously considering an early necessity for earning their living.

Our critics have suggested that in any reconstruction of the mathematics course there should be included a year's work of such comprehensive character that the pupil might obtain from it a general idea of what mathematics was about, so that his further pursuit of the subject could be grounded upon a more or less intelligent appreciation.

Our committee has dealt with several phases of the subject; and what I propose to speak of to-day is a tentative plan for reconstruction which is intended to meet the suggestion of our

* Read at the spring meeting of the Association.

friends the enemy. We have had the advantage of informal cooperation with a committee of public-school teachers in Boston who have been asked by the school authorities to propose a mathematics program for a so-called junior high school. This, as you know, is intended as a reorganization of the seventh, eighth and ninth grades into a school intermediate between the elementary school and the secondary school. One of the topics of the reconstructed course has been approximate computation. You are familiar with it. It involves the rejection of superfluous numbers in the course of the computation, and not merely at the end: the estimation of the accuracy of data and of results by the number of significant figures rather than by the number of decimal places; and the systematic teaching of such checks as can be used without the retention of all figures. This retention would, of course, be necessary in using such checks as casting out nines.

We have had some difficulty in persuading teachers of the subject to begin multiplying from the left-hand end of the multiplier. The current method, by which we begin at the right-hand end of the multiplier, was originally an alternate to the one that we are now recommending, and was fixed upon in the usage of schools for no good reason that I can discover. Multiplying from the left-hand end was a companion of the early use of decimal fractions at the beginning of the seventeenth century; but since this was very soon followed by the invention of logarithms, it was probably felt that approximate computation could be left to the man with the logarithm table. At any rate, the wrong way was, up to the beginning of the present century, pretty firmly intrenched in the school system.

Very curiously, the most conservative country in the world, England, has within the last fifteen years completely changed in this important respect. When John Perry proposed the reform at the Glasgow meeting in 1901 (or 1902—I forget which), multiplying from the right-hand end was so fixed a custom that he suggested re-writing the multiplier wrong end to, so that the computer could feel that he was adhering to his grandfather's ways. The custom now seems to be so universal to follow the other order that a questionnaire in arithmetic issued by the Mathematics Association in England proposed several methods

of fixing the decimal point, and in all of them the reverse order of multiplication (it should really be called the natural order) is given without apparent alternative, quite as a matter of course.

In our proposed reconstruction, this is led up to through the other grades, so that in the ninth grade, for the first time, the pupil gets the complete system of approximate computation, including the rejection of figures in the course of his work.

Other topics include algebra and some geometry. Algebra it is proposed to introduce by means of formulæ which are presented as systematic abbreviations of arithmetical rules, and problems which the pupil is told he must still use arithmetic for. He can, however, systematically abbreviate the explanation of these problems in such a way that, having put down the reasoning in successive steps, he shall soon be enabled to follow the explanation of a problem that was previously quite beyond his reach. Gradually increasing algebraic difficulties are introduced by new problems; the pupil having in mind always that his algebra is for the purpose of solving these problems. Problems selected for this use will not conform to the requirement of immediate practical application. In this connection I should like to refer you to Mr. Carson's book on the teaching of mathematics, published by Ginn & Company last year. What he has to say about real problems is an interesting reply to the criticisms that are now fashionable. It may be noted, also, that the practical problems in arithmetic used almost exclusively in elementary schools are those that refer to the counting room. Problems that have to do with measurements have been much neglected.

Mr. Carson's book has also much to say about the proofs usually given at the beginning of instruction in geometry.

The program that we have been considering includes a dozen or more of the most important propositions in elementary geometry, including the Pythagorean theorem, measurement theorems, and the principle of similarity. Proofs have been prepared for these propositions which our teachers believe do not unnecessarily insist upon what a mathematician would call rigor. These proofs aim rather to satisfy the doubts of pupils in regard to the necessary and inevitable character of the inferences that they are called upon to make. Truths that they accept

without demonstration are not encumbered with demonstration; nevertheless, enough demonstration is included to enable the pupil to get the idea of successive logical dependence, which is really the main lesson of elementary geometry teaching.

It is proposed to begin in Boston a year from next September some twenty of these junior high school units, in different sections of the city, where the conditions of the school organization seem to warrant the change. Our greatest difficulty will be, as always, the lack of text-books, and the difficulty of co-ordinating new material in a system so completely organized. We hope to have enthusiastic co-operation on the part of a great many teachers who have already expressed a warm interest in the proposition.

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EUCLID'S FALSE AXIOM.

By William A. Francis.

As youth gives place to creeping age,
One by one our idols fall;
We read anew life's blotted page;
Our gods are gone for good and all.

In youth I read in weighty tome:
"Hairs of thy head all numbered are."
With age the message sad comes home:
"The numbers go not very far."

In youth I read on Euclid's page:
"The whole is greater than the part."
I cried: "How true, O wondrous sage!
This is a fact that stirs the heart!"

With age my hair is wholly gone;
I view with pain a polished poll.
I find false Euclid quite forsworn;
The part is equal to the whole.